

PTO/PCT Rec'd 07 JAN 2002

10/030286

Preliminary Classification:

Proposed Class:

Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example "Proposed Class 2, subclass 129." M.P.E.P., § 601, 7th ed.

**TRANSMITTAL LETTER**  
**TO THE UNITED STATES ELECTED OFFICE (EO/US)**  
**(ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FI00/00620	6 July 2000	9 July 1999
TITLE OF INVENTION		
METHOD FOR TRANSMITTING A SEQUENCE OF SYMBOLS		
APPLICANT(S)		
Sari KORPELA, Janne KOIVISTO, Kaj JANSEN		

**Box PCT**  
**Assistant Commissioner for Patents**  
**Washington D.C. 20231**  
**ATTENTION: EO/US**

**CERTIFICATION UNDER 37 C.F.R. §§ 1.8(a) and 1.10\***  
*(When using Express Mail, the Express Mail label number is mandatory;  
Express Mail certification is optional.)*

I hereby certify that, on the date shown below, this correspondence is being:

**MAILING**

- ☒ deposited with the United States Postal Service in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231

37 C.F.R. § 1.8(a)

37 C.F.R. § 1.10 \*

- ☐ with sufficient postage as first class mail.

- ☒ as "Express Mail Post Office to Addressee"

Mailing Label No. EL627511485US (mandatory)

**TRANSMISSION**

- ☐ facsimile transmitted to the Patent and Trademark Office, (703) \_\_\_\_\_

Signature

Deborah J. Clark

(type or print name of person certifying)

Date: January 7, 2002

\* Only the date of filing (§ 1.6) will be the date used in a patent term adjustment calculation, although the date on any certificate of mailing or transmission under § 1.8 continues to be taken into account in determining timeliness. See § 1.703(f). Consider "Express Mail Post Office to Addressee" (§ 1.10) or facsimile transmission (§ 1.6(d)) for the reply to be accorded the earliest possible filing date for patent term adjustment calculations.

NOTE: To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and (2) the basic national fee (see 37 C.F.R. § 1.492(a)). The 30-month time limit may not be extended. 37 C.F.R. § 1.495.

WARNING: Where the items are those which can be submitted to complete the entry of the international application into the national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. § 1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing—See 37 C.F.R. § 1.8.

NOTE: Documents and fees must be clearly identified as a submission to enter the national state under 35 U.S.C. § 371 otherwise the submission will be considered as being made under 35 U.S.C. § 111. 37 C.F.R. § 1.494(f).

- I. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. § 371:
- a. ☒ This express request to immediately begin national examination procedures (35 U.S.C. § 371(f)).
  - b. ☒ The U.S. National Fee (35 U.S.C. § 371(c)(1)) and other fees (37 C.F.R. § 1.492) as indicated below:

## 2. Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
<input type="checkbox"/> *	TOTAL CLAIMS				
	16	16 - 20 =	0	× \$18.00 =	\$ 0
	INDEPENDENT CLAIMS				
	3	3 - 3 =	0	× \$84.00 =	0
	MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ \$ 280.00 =
BASIC FEE**	<input type="checkbox"/> U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where an international preliminary examination fee as set forth in § 1.482 has been paid on the international application to the U.S. PTO: <input type="checkbox"/> and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(1) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 C.F.R. § 1.492(a)(4)) ..... \$100.00 <input type="checkbox"/> and the above requirements are not met (37 C.F.R. § 1.492(a)(1)) ..... \$ 710.00 <input checked="" type="checkbox"/> U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where no international preliminary examination fee as set forth in § 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in § 1.445(a)(2) to the U.S. PTO: <input checked="" type="checkbox"/> has been paid (37 C.F.R. § 1.492(a)(2)) ..... \$ 740.00 <input type="checkbox"/> has not been paid (37 C.F.R. § 1.492(a)(3)) ..... \$1,040.00 <input type="checkbox"/> where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 C.F.R. § 1.492(a)(5)) ..... \$ 890.00				740.00
	Total of above Calculations				= 740.00
SMALL ENTITY	Reduction by 1/2 for filing by small entity, if applicable. Assertion must be made. (note 37 C.F.R. § 1.27)				-
	Subtotal				740.00
	Total National Fee				\$ 740.00
	Fee for recording the enclosed assignment document \$40.00 (37 C.F.R. § 1.21(h)). (See Item 13 below). See attached "ASSIGNMENT COVER SHEET".				40.00
TOTAL	Total Fees enclosed				\$ 780.00

\*See attached Preliminary Amendment Reducing the Number of Claims.

- ☒ Attached is a ☒ check ☐ money order in the amount of \$ 780.00
- ☐ Authorization is hereby made to charge the amount of \$ \_\_\_\_\_
- ☒ to Deposit Account No. 16-1350
- ☐ to Credit card as shown on the attached credit card information authorization form PTO-2038.

**WARNING:** Credit card information should not be included on this form as it may become public.

- ☒ Charge any additional fees required by this paper or credit any overpayment in the manner authorized above.

A duplicate of this paper is attached.

**WARNING:** "To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: \* \* \* (2) the basic national fee (see § 1.492(a)). The 30-month time limit may not be extended." 37 C.F.R. § 1.495(b).

**WARNING:** If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. § 1.495(b)(2). The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 apply to the period which is set. Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.

- ☐ Assertion of Small Entity Status
- ☐ Applicant hereby asserts status as a small entity under 37 C.F.R. § 1.27.

**NOTE:** 37 C.F.R. § 1.27(c) deals with the assertion of small entity status, whether by a written specific declaration thereof or by payment as a small entity of the basic filing fee or the fee for the entry into the national phase as states:

"(c) Assertion of small entity status. Any party (person, small business concern or nonprofit organization) should make a determination, pursuant to paragraph (f) of this section, of entitlement to be accorded small entity status based on the definitions set forth in paragraph (a) of this section, and must, in order to establish small entity status for the purpose of paying small entity fees, actually make an assertion of entitlement to small entity status, in the manner set forth in paragraphs (c)(1) or (c)(3) of this section, in the application or patent in which such small entity fees are to be paid.

(1) Assertion by writing. Small entity status may be established by a written assertion of entitlement to small entity status. A written assertion must:

- (i) Be clearly identifiable;
  - (ii) Be signed (see paragraph (c)(2) of this section); and
  - (iii) Convey the concept of entitlement to small entity status, such as by stating that applicant is a small entity, or that small entity status is entitled to be asserted for the application or patent. While no specific words or wording are required to assert small entity status, the intent to assert small entity status must be clearly indicated in order to comply with the assertion requirement.
- (2) Parties who can sign and file the written assertion. The written assertion can be signed by:
- (i) One of the parties identified in §§ 1.33(b) (e.g., an attorney or agent registered with the Office), §§ 3.73(b) of this chapter notwithstanding, who can also file the written assertion;
  - (ii) At least one of the individuals identified as an inventor (even though a § 1.63 executed oath or declaration has not been submitted), notwithstanding §§ 1.33(b)(4), who can also file the written assertion pursuant to the exception under §§ 1.33(b) of this part; or
  - (iii) An assignee of an undivided part interest, notwithstanding §§ 1.33(b)(3) and 3.73(b) of this chapter, but the partial assignee cannot file the assertion without resort to a party identified under §§ 1.33(b) of this part.

(3) Assertion by payment of the small entity basic filing or basic national fee. The payment, by any party, of the exact amount of one of the small entity basic filing fees set forth in §§ 1.16(a), (f), (g), (h), or (k), or one of the small entity basic national fees set forth in §§ 1.492(a)(1), (a)(2), (a)(3), (a)(4), or (a)(5), will be treated as a written assertion of entitlement to small entity status even if the type of basic filing or basic national fee is inadvertently selected in error.

(j) If the Office accords small entity status based on payment of a small entity basic filing or basic national fee under paragraph (c)(3) of this section that is not applicable to that application, any balance of the small entity fee that is applicable to that application will be due along with the appropriate surcharge set forth in §§ 1.16(e), or §§ 1.16(f).

(i) The payment of any small entity fee other than those set forth in paragraph (c)(3) of this section (whether in the exact fee amount or not) will not be treated as a written assertion of entitlement to small entity status and will not be sufficient to establish small entity status in an application or a patent."

3. ☒ A copy of the International application as filed (35 U.S.C. § 371(c)(2)):

NOTE: Section 1.495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.

- a. ☒ is transmitted herewith.
- b. ☐ is not required, as the application was filed with the United States Receiving Office.
- c. ☐ has been transmitted
  - i. ☐ by the International Bureau.  
Date of mailing of the application (from form PCT/1B/308):  
\_\_\_\_\_
  - ii. ☐ by applicant on \_\_\_\_\_ (Date)

4. ☒ A translation of the International application into the English language (35 U.S.C. § 371(c)(2)):

- a. ☐ is transmitted herewith.
- b. ☒ is not required as the application was filed in English.
- c. ☐ was previously transmitted by applicant on \_\_\_\_\_ (Date)
- d. ☐ will follow.

5. ☒ Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. § 371(c)(3)):

NOTE: The Notice of January 7, 1993 points out that 37 C.F.R. § 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that: "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under section 1.121. In many cases, filing an amendment under section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.

- a. ☐ are transmitted herewith.  
b. ☐ have been transmitted  
i. ☐ by the International Bureau.

Date of mailing of the amendment (from form PCT/1B/308):  
\_\_\_\_\_

- ii. ☐ by applicant on \_\_\_\_\_ (Date)  
c. ☒ have not been transmitted as  
i. ☒ applicant chose not to make amendments under PCT Article 19.  
Date of mailing of Search Report (from form PCT/ISA/210.):  
11/15/00  
ii. ☐ the time limit for the submission of amendments has not yet expired. The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. ☒ A translation of the amendments to the claims under PCT Article 19 (38 U.S.C. § 371(c)(3)):

- a. ☐ is transmitted herewith.  
b. ☐ is not required as the amendments were made in the English language.  
c. ☒ has not been transmitted for reasons indicated at point 5(c) above.

7. ☒ A copy of the international examination report (PCT/IPEA/409)

- ☒ is transmitted herewith.  
☐ is not required as the application was filed with the United States Receiving Office.

8. ☒ Annex(es) to the international preliminary examination report

- a. ☒ Is/are transmitted herewith.  
b. ☐ Is/are not required as the application was filed with the United States Receiving Office.

9. ☒ A translation of the annexes to the international preliminary examination report

- a. ☐ is transmitted herewith.  
b. ☒ is not required as the annexes are in the English language.

(Transmittal Letter to the United States Elected Office (EO/US) [13-18]—page 6 of 9)

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10. ☒ An oath or declaration of the inventor (35 U.S.C. § 371(c)(4)) complying with 35 U.S.C. § 115

- a. ☐ was previously submitted by applicant on \_\_\_\_\_. (Date)
- b. ☒ is submitted herewith, and such oath or declaration
  - i. ☒ is attached to the application.
  - ii. ☒ identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and states that they were reviewed by the inventor as required by 37 C.F.R. § 1.70.

c. ☐ will follow.

II. Other document(s) or information included:

11. ☒ An International Search Report (PCT/ISA/210) or Declaration under PCT Article 17(2)(a):

- a. ☒ is transmitted herewith.
- b. ☐ has been transmitted by the International Bureau.  
Date of mailing (from form PCT/IB/308): \_\_\_\_\_
- c. ☐ is not required, as the application was searched by the United States International Searching Authority.
- d. ☐ will be transmitted promptly upon request.
- e. ☐ has been submitted by applicant on \_\_\_\_\_. (Date)

12. ☒ An Information Disclosure Statement under 37 C.F.R. §§ 1.97 and 1.98:

- a. ☒ is transmitted herewith.

Also transmitted herewith is/are:

- ☒ Form PTO-1449 (PTO/SB/08A and 08B).
- ☒ Copies of citations listed.

- b. ☐ will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. § 371(c).
- c. ☐ was previously submitted by applicant on \_\_\_\_\_. (Date)

13. ☒ An assignment document is transmitted herewith for recording.

A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

14. ☒ Additional documents:
- a. ☒ Copy of request (PCT/RO/101)
- b. ☒ International Publication No. WO 01/05061 A1
- i. ☒ Specification, claims and drawing
- ii. ☐ Front page only
- c. ☒ Preliminary amendment (37 C.F.R. § 1.121)
- d. ☒ Other  
PCT/IPEA/401; PCT/IPEA/409; PCT/IPEA/408; Reply to Written Opinion;  
PCT/IB/306
15. ☒ The above checked items are being transmitted
- a. ☒ before 30 months from any claimed priority date.
- b. ☐ after 30 months.
16. ☐ Certain requirements under 35 U.S.C. § 371 were previously submitted by the applicant on \_\_\_\_\_, namely:

### AUTHORIZATION TO CHARGE ADDITIONAL FEES

**WARNING:** Accurately count claims, especially multiple dependant claims, to avoid unexpected high charges if extra claims are authorized.

**NOTE:** "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(e) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(e)(3).

NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

- ☒ Please charge, in the manner authorized above, the following additional fees that may be required by this paper and during the entire pendency of this application:
- ☒ 37 C.F.R. § 1.492(a)(1), (2), (3), and (4) (filing fees)

**WARNING:** Because failure to pay the national fee within 30 months without extension (37 C.F.R. § 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.



- ☒ 37 C.F.R. § 1.492(b), (c) and (d) (presentation of extra claims)

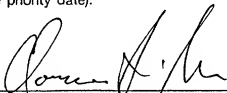
NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.

- ☒ 37 C.F.R. § 1.17 (application processing fees)  
☒ 37 C.F.R. § 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)).  
☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

- ☒ 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).



SIGNATURE OF PRACTITIONER

Clarence A. Green

(type or print name of practitioner)

PERMAN & GREEN, LLP

P.O. Address

425 Post Road, Fairfield, CT 06430 USA

Reg. No.: 24,622

Tel. No.: 203 . . . 259-1800

Customer No.: 2512

JC13 Rec'd PCT/PTO 07 JAN 2002

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Express Mail No.: EL627511485US

In re Application of: KORPELA et al.

INTERNATIONAL APPLICATION NO.: PCT/FI00/00620

INTERNATIONAL FILING DATE: 7/6/00

TITLE: METHOD FOR TRANSMITTING A SEQUENCE OF SYMBOLS

ATTORNEY DOCKET NO.: 297-010742-US(PAR)

Box PCT  
Commissioner of Patents  
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

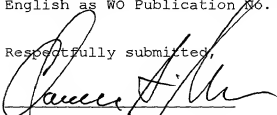
Please amend the above-identified, patent application as follows:

IN THE SPECIFICATION:

After the Title and before the first paragraph, please insert the following new paragraph:

--(New) This application claims the benefit of the earlier filed International Application No. PCT/FI00/00620, International Filing Date, July 6, 2000, which designated the United States of America, and which international application was published under PCT Article 21(2) in English as WO Publication No. WO 01/05061 A1.--

Respectfully submitted,

  
Clarence A. Green Reg. No.: 24,622  
PERMAN & GREEN, LLP  
425 Post Road, Fairfield, CT 06430  
(203) 259-1800  
Customer No.: 2512

Date  
7 Jan 02

Method for transmitting a sequence of symbols

The invention relates in general to transmission of a certain sequence of symbols. In particular the invention relates to diversity transmissions where the symbols belonging to the sequence are sent using at least two antennas.

In cellular networks the downlink and uplink radio transmissions comprise synchronization channels, which can be special synchronization symbols. Using the information carried in the synchronization symbols, for example, the receiver can determine the timing of the transmission. Information is usually sent in frames, and the frames consist of a certain number of time slots. The time slots, in turn, consist of a certain number of symbols. If synchronization symbols are used, they can be sent, for example, once in each time slot. It is also possible to send synchronization information in bursts, so that more information is sent at a time, but synchronization information is sent less frequently than once in a time slot. From the synchronization information it is possible to determine both the time slot timing and the frame timing, i.e. where time slots and frames start.

The synchronization symbols may carry also other information than just indicate timing. For example, in Wideband Code Division Multiple Access (WCDMA) cellular networks the synchronization symbols carry certain information about the spreading code that a base station uses to spread the downlink transmissions. In a handover, for example, the mobile station entering a new cell can determine the part of the downlink spreading code with the help of the synchronization symbols. The mobile station needs to know the spreading code in order to find out the control information transmitted via the common control channel. Otherwise it cannot, for example, communicate with the radio access network after power up or in a handover situation receive from the new cell cell-specific control information that is needed to perform the handover.

Traditionally information is transmitted over radiolink using a single antenna. Transmission diversity refers to sending information via more than one antennas.

The transmitted information can be, for example, encoded so that the transmitted symbol flows are not equal, but the original information flow can be determined from each transmitted symbol flow. The receiver can, for example, choose special decoding scheme in case transmission diversity is used and deduce the transmitted information. The synchronization symbols can carry information also about the use

of some transmission diversity scheme. It is important that the receiver can determine the sent synchronization symbol correctly. Otherwise, for example, it may fail to identify the transmission diversity and encoding schemes that are used.

Fig. 1 represents a typical WCDMA cell 100, where there is a base station 101 in the middle of the cell. There are also two mobile stations 102 and 103 in the Fig. 1, and the communication between each mobile station and the base station is indicated with arrows. The base station broadcasts common control information to all the mobile stations in the cell, and it spreads this common control information with a certain spreading code. In a WCDMA system, a spreading code usually consists of two parts: a long scrambling code  $C_s$  and a short channelization code  $C_c$ . The scrambling code is effective to eliminate, for example, the effect of multipath propagation. The channelization codes that are used within a cell are orthogonal, and they are effective to distinct, for example the transmission to each mobile station. In a WCDMA system, within a cell a same scrambling code  $C_s$  may be used for all downlink transmissions. The downlink transmission are synchronized, and therefore the different channelization codes are enough for successful despreading of the transmitted signals. In the neighboring cells, other scrambling codes are used so that adjacent cells do not disturb each other's transmissions.

The use of spreading codes in downlink transmission is presented in Fig. 1, where the arrow 111 represents the common control information broadcast. The spreading code can be presented as the product of the scrambling and channelization codes  $C_{cc} = C_s C_c$ . When entering a new cell, the mobile station can determine the downlink scrambling code  $C_s$  from the broadcast transmission the base station sends. The channelization code related to common control information is typically a fixed constant throughout the WCDMA system, so after determining the downlink scrambling code and the frame timing, the mobile station can determine the common control information.

The arrow 112 in Fig. 1 represents the downlink transmission to the mobile station 102, and the arrow 113 represents the downlink transmission to the mobile station 103. The spreading code  $C_{D1}$  for the downlink connection to the mobile station 102 is  $C_{D1} = C_s C_{c1}$ , and the spreading code  $C_{D2}$  for the downlink connection to the mobile station 103 is  $C_{D2} = C_s C_{c2}$ . Since the uplink transmissions are not synchronized and each mobile has its own radio channel from the mobile station to the base station, each mobile station may use a specific scrambling code, and various channels, for example, to a certain mobile station may be separated using various channelization codes. The downlink and uplink spreading codes for

connections terminating to a mobile station are usually established either when a mobile station enters a new cell or when a new connection is established between the mobile station and the radio access network.

Fig. 2 shows some of the common channels a base station in a WCDMA system generally transmits. The pilot symbols are transmitted over a common pilot channel (CPICH) 201. The pilot symbols are usually sent 100% of the duty cycle. The pilot symbols are predetermined, and CPICH is spread using the downlink scrambling code  $C_s$  and a fixed channelization code.

The synchronization channel (SCH) 202 occupies typically 10% of the duty cycle in the beginning of each time slot 210. The frame 211, which comprises a certain fixed number of time slots, is also presented in Fig. 2. The synchronization channel carries two synchronization codes: a primary synchronization code 203 and a secondary synchronization code 204. These codes are transmitted simultaneously within one symbol period. Both the primary and secondary synchronization codes can be modulated, for example, with the same symbol, and because the codes have good crosscorrelation properties the receiver can distinguish the codes. A mobile station entering a new cell or measuring a new cell in the neighborhood may always receive successfully information broadcast over the SCH.

The primary synchronization code is a constant code that denotes the beginning of the time slots. The secondary synchronization codes, which form a synchronization code sequence or word, indicate the timing of the frames. In addition to the frame timing, the second synchronization code sequence within a frame indicates the scrambling code group to which the downlink scrambling code the base station uses belongs. A mobile station entering a new cell may determine the downlink scrambling code, for example, by testing the scrambling codes of the indicated scrambling code group on the CPICH. The correct scrambling code  $C_s$  is the one that with the known channelization code produces from the received radio signal the known transmitted pilot symbols.

Once the scrambling code  $C_s$  has been determined, the received pilot symbols may be used, for example, for determining the complex channel coefficient. In general, the radio signal that is received is not exactly the same as the transmitted one. The signal may experience changes in amplitude and phase, and these changes are time-dependent. They are taken into account using the complex channel coefficient  $h$  when the despread signal is processed. An estimate  $\hat{h}$  for the channel coefficient can be determined by comparing the received pilot symbols to the known trans-

mitted pilot symbols. The channel coefficient may be assumed to be constant during the time over which the pilot symbol and the studied symbol are transmitted.

Common control information is transmitted using, for example, a Primary Common Control Physical Channel (PCCPCH) 205. PCCPCH is transmitted 90% of the duty cycle, at the time when the synchronization symbols are not sent. It is spread using a predetermined channelization code and the downlink scrambling code, as discussed above. After the scrambling code has been identified, the mobile station may despread the CCPCCH information from the spread signal it receives. The information may be, for example, information related to the logical Broadcast Control Channel (BCCH). The mobile station needs the BCCH information, for example, to start communicating with the radio access network after power up or to make a successful handover.

Fig. 2 represents a situation where the base station uses only one antenna TX1 for broadcasting information. When transmission diversity is employed, there are at least two antennas where the information may be transmitted. It is preferable that each antenna transmits its own pilot signal, so that the channel coefficient estimates can be determined for each antenna. The radio waves emitted for the two transceivers may propagate in different ways to the antenna of the mobile station.

Fig. 3 represents some broadcast channels when transmission diversity and two antennas TX1 and TX2 are in use. The antenna TX1 transmits the common pilot channel CPICH 201 similarly as when no transmission diversity is employed. The antenna TX2 transmits an auxiliary pilot 301. The synchronization symbols may be transmitted using only one antenna or both antennas. In time switched transmit diversity (TSTD) both antennas are used to transmit the symbols, one at a time. Fig. 3 shows how the synchronization symbols are transmitted using TSTD and an alternating transmission pattern. For example, the synchronization symbol 302 is transmitted from the antenna TX1 and the synchronization symbol 303 is transmitted from the antenna TX2. Each synchronization symbol carries both the primary and the secondary synchronization code.

The common control information may be also transmitted from both antennas TX1 and TX2. In this case the BCCH information, for example, is encoded before it is transmitted over the PCCPCH channel. Space time transmit diversity (STTD), for example, specifies that from the primary antenna TX1 the symbols are transmitted as such, i.e. the sequence of transmitted symbols is  $S_1, S_2, S_3, S_4, \dots$ . From the second antenna TX2 the sequence of transmitted symbols starts in the following

way:  $-S_2^*, S_1^*, -S_4^*, S_3^*, \dots$ , where the asterisk indicates the complex conjugate. Fig. 3 presents the PCCPCH data 304 transmitted from the antenna TX1 and the PCCPCH data 305 transmitted from the antenna TX2. It is possible also to use the space time transmit diversity for the BCCH information but transmit all the synchronization symbols from one antenna.

The base station may indicate the use of diversity scheme and two transceivers, for example, by transmitting a specific message on a broadcast channel or modulating the synchronization symbols. A certain synchronization symbol value indicates that the STTD is on, and another value indicates that it is off. The mobile station may also determine the use of a diversity scheme by detecting the auxiliary pilot symbols. The mobile station may also use all three indicators of the diversity scheme.

When the mobile station detects the presence of STTD using the synchronization symbol, the value of the synchronization symbol needs to be determined reliably. When a certain symbol needs to be determined, the effect of the channel coefficient has to be taken into account. The mobile station receives the following signal  $r$

$$r = h s_{SCH} + n$$

where  $h$  represents the complex channel coefficient,  $s_{SCH}$  represents the synchronization symbol and  $n$  represent the noise.

When the received signal  $r$  is multiplied by the complex conjugate of the channel coefficient estimate  $\hat{h}^*$

$$\hat{h}^* r = \hat{h}^* (h s_{SCH} + n) = \hat{h}^* h s_{SCH} + \hat{h}^* n$$

the result is the synchronization symbol scaled with a scalar  $\hat{h}^* h$  and the term related to noise. From here it is quite straightforward to infer the value of the synchronization symbol.

Above, the synchronization symbols have been used as an example of a sequence of symbols that is transmitted using two antennas. The problem is that when the TSTD diversity scheme is in use, the mobile station cannot necessarily distinguish from which antenna a certain synchronization symbol, or any other symbol that is transmitted using a time switched diversity scheme, is transmitted. Consider, for example, a situation where a certain sequence of symbols is transmitted once is every time slot, and a frame consists of an odd number of time slots. If the symbols

belonging to the sequence are transmitted using a time switched diversity scheme, two diversity antennas are used and the transmission pattern is an alternating pattern, in a certain time slot the symbol belonging to the sequence is transmitted from one antenna in every other frame and in the rest of the frames from the other antenna. Therefore the mobile station does not know, which channel coefficient estimate to use for a symbol sent in a certain time slot with a time switched transmission scheme.

To obtain a reliable result, the signal transmitted by the primary transceiver has to be processed with the channel coefficient estimate  $\hat{h}_1$  determined from the primary pilot and the signal transmitted by the secondary transceiver has to be processed with the channel coefficient estimate  $\hat{h}_2$  determined from the auxiliary pilot. Not knowing from which antenna a certain symbol is transmitted causes unnecessary interference to the decision which symbol was sent. In case of synchronization symbols, this may cause that the mobile station cannot utilize the transmission diversity of, for example, the common control information for enhancing the quality of the received signal. Consequently, if the transmission diversity is in use, but the receiver does not notice this, the quality of the received common control signal may be poorer than in a case where no transmission diversity is applied.

The object of the invention is to provide a versatile method for transmitting a sequence of symbols using at least two antennas. A further object of the invention is that the method enables to determine unambiguously from which antenna a symbol belonging to sequence is transmitted.

The objects of the invention are achieved by starting the time switched transmit diversity pattern of the sequence of symbols always from the same antenna in the beginning of a frame and by using the same pattern in each frame.

A method according to the invention is a method for transmitting a certain sequence of symbols, where

- a frame is constructed of a certain number of consecutive symbols,
- the symbols belonging to the sequence are transmitted using at least two antennas and
- the transmission of the sequence of symbols is characterized with a certain transmission pattern, and it is characterized in that
- the transmission of the sequence of symbols is started from a predefined antenna and



- when a partial transmission pattern is used in the end of a frame, the transmission pattern is started from the beginning in the beginning of a next frame.

An arrangement according to the invention is an arrangement, which comprises control means for controlling the transmission of a sequence of symbols according to a certain transmission pattern and using at least two antennas, and it is characterized in that it further comprises

- indication means for indicating the antenna from which to transmit the first symbol belonging to the sequence and

- starting means for starting the transmission pattern from the beginning in the beginning of a next frame, when a partial transmission pattern is used in the end of a frame.

A network element according to the invention is a network element, which comprises control means for controlling the transmission of a sequence of symbols according to a certain transmission pattern and using at least two antennas, and it is characterized in that it further comprises

- indication means for indicating the antenna from which to transmit the first symbol belonging to the sequence and

- starting means for starting the transmission pattern from the beginning in the beginning of a next frame, when a partial transmission pattern is used in the end of a frame.

In a method according to the invention a sequence of symbol is transmitted using at least two antennas. The transmission of the symbols belonging to the sequence is characterized with a transmission pattern. Here the term transmission pattern refers to a pattern that specifies both from which antenna a symbol is transmitted and at which time the symbol is transmitted. The pattern may consist, for example, of a sequence of pattern items, and each of the pattern items corresponds to a certain period of time. A pattern item may be represented, for example, by a number indicating an antenna. For example, a pattern 1, 2, 0, 2, 2, 0, 1, ..., where each number corresponds to a time slot, would indicate that a first symbol of the sequence is transmitted in a first time slot using a first antenna, a second symbol of the sequence is transmitted using a second antenna in a second time slot and in the third time slot no symbol belonging to the sequence is transmitted. In the fourth time slot, a third symbol of the sequence is transmitted using the second antenna, and so forth.

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In the method according to the invention the antenna to transmit the first symbol belonging to the sequence is predefined. This means that a certain physical antenna is associated to the first antenna of the transmission pattern. The receiver thus

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knows which of the pilot signals is transmitted by the same antenna as the first symbols of the sequence, and it may use the correct channel coefficient estimate in processing the first symbol of the sequence. If, for example, the first symbol of the sequence is transmitted using the primary antenna that transmits the common pilot, the channel coefficient estimate determined from the common pilot is used to process the received first symbol.

Further, in the method according to the invention, the transmission pattern is started from the beginning in the beginning of each frame. Even if the receiver starts to receive the signal in the middle of the transmission, it knows explicitly that in each frame the first symbol belonging to the sequence is transmitted using a predefined antenna, for example, the primary antenna.

The advantage of the method according to the invention is thus that the receiver knows for certain at least the antenna from which in each frame the first symbol belonging to the symbol sequence is transmitted. It may thus process at least these symbols with the correct channel coefficient estimate. This removes unnecessary interference in the decision process where the received symbol is determined. When the method according to the invention is in use, at least some of the symbols of the sequence can thus be received reliably.

Usually the receiver knows the transmission pattern, and if two antennas are used to transmit the symbol sequence, the information from which antenna the first symbol in each frame is transmitted reveals the transmission antennas of all the symbols in that frame. A further advantage of the invention is thus that in a case where two diversity antennas are used and the receiver knows the transmission pattern, the receiver can process all received symbols belonging to the sequence with correct channel coefficient estimations and determine the received symbols reliably.

If more than two diversity antennas are in use, the method according to the invention can be applied, too. If  $n$  diversity antennas are in use and at least  $n-1$  antennas in the transmission pattern are associated to physical antennas, then a receiver who knows the transmission pattern, can use correct channel coefficient estimation for all the received symbols belonging to the sequence and determine their values reliably.

The invention will now be described more in detail with reference to the preferred embodiments by the way of example and to the accompanying drawings where

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- Fig. 1 shows a schematic drawing of a base station communicating with two mobile terminals in WCDMA system,
- Fig. 2 shows a schematic drawing of some of the common broadcast channels in WCDMA system,
- 5 Fig. 3 shows a schematic drawing of some of the common broadcast channels in WCDMA system when transmission diversity is in use,
- Fig. 4 shows a flowchart of method according to a first preferred embodiment of the invention,
- 10 Fig. 5 shows a flowchart of method according to a second preferred embodiment of the invention,
- Fig. 6 shows a flowchart of a method according to a third preferred embodiment of the invention and
- Fig. 7 shows a schematic drawing of a network element and an arrangement that employ a method according to the invention.
- 15 Above in conjunction with the description of the prior art reference was made to Figs. 1-3. The same reference numerals are used for corresponding parts in the figures.
- Fig. 4 shows a flowchart of a method 400 according to a first embodiment of the invention. A sequence of symbols is transmitted using a specified transmission  
20 pattern. The symbols belonging to the sequence are marked with  $S$ . In step 401 the transmission pattern that characterizes the transmission of a certain sequence of symbols is defined. In step 402 the antenna which transmits the first symbol  $S$  of the sequence is defined. Thereafter the actual transmission of symbols  $S$  belonging to the sequence begins.
- 25 In step 403 the transmission pattern is reset, so that the next symbol  $S$  of the sequence is transmitted according to the first item of the transmission pattern. In step 404 symbols of the sequence are transmitted according to the transmission pattern. Step 405 is carried out simultaneously with the transmission in step 404, and when the beginning of a new frame is detected in step 405, the transmission  
30 pattern is reset in step 403 and the next symbol  $S$  of the sequence is transmitted as the first item of the transmission pattern specifies.

Because the transmission pattern specifies the time at which the symbols  $S$  are sent, the length of the transmission pattern can be measured in units of time. The length of the transmission pattern can be expressed, for example, in time slots. If the transmission pattern is longer than a frame, then in a method according to this first preferred embodiment of the invention only a certain number (corresponding to the length of a frame) of items in the beginning of the transmission pattern is used. If the transmission is shorter than a frame, then symbols  $S$  are transmitted only in the first part of the frame in a method according to the first preferred embodiment of the invention.

- 10 In a method according to the first embodiment of the invention, in each frame a same number of symbols  $S$  is transmitted. The first of these symbols  $S$  within a frame is always sent using the predefined antenna. In fact, each of the symbols  $S$  within a frame in the consecutive frames are transmitted using a certain antenna. The symbols  $S$  are thus transmitted similarly in each frame (although the values of the symbols, for example in certain time slots in consecutive frames, need not be same).

Fig. 5 shows a flowchart of a method 500 according to a second preferred embodiment of the invention. In this method, if the length of the transmission pattern is shorter than a frame, the transmission pattern is repeated in a certain way.

- 20 This ensures that the symbols  $S$  of the sequence are transmitted during the whole frame.

The method 500 begins similarly as the method 400 according to the first preferred embodiment of the invention. In step 401 the transmission pattern is defined and in step 402 the antenna which transmits the first symbol  $S$  of the sequence. In step 403 the transmission pattern is started from the beginning.

- 25 In step 501 it is checked, if the length of the rest of the frame is longer than or equal to a complete transmission pattern. If it is, then in step 502 symbols  $S$  are transmitted using the complete transmission pattern, and thereafter the length of the rest of the frame is checked again. In this method, the transmission pattern is thus  
30 repeated during a frame as many times as it can be repeated completely.

When the end of the frame is near, i.e. the length of the rest of the frame is less than the length of the transmission pattern, then in step 503 symbols  $S$  are transmitted using only a certain part of the transmission pattern. The length of this part is equal to the remainder of the length of a frame divided by the length of the transmission

pattern. Thereafter the transmission pattern is started from the beginning in step 403, and symbols  $S$  are again transmitted using the complete transmission pattern in step 502. The part of the transmission pattern can be selected, for example, from the beginning of the pattern.

- 5 The advantage of this method according to the second preferred embodiment of the invention is that even if the transmission pattern is shorter than a frame and the length of a frame is not a multiple of the transmission pattern, it is possible to transmit symbols  $S$  of the sequence throughout a frame by repeating the transmission pattern and be certain that in each frame the symbols  $S$  of the sequence are  
10 transmitted using the diversity antennas similarly.

This method works also if the length of the transmission pattern is longer than the frame. In that case step 502 is never entered, and only a certain part of the transmission pattern is used in sequential steps 503.

- 15 Fig. 6 shows a more detailed flowchart of a transmission method 600 according to a third preferred embodiment of the invention. In this method, the diversity antenna that transmits the first symbol of the sequence is also specified, although this is not shown in Fig. 6. In this method, if the transmission pattern is short, it is repeated within a frame similarly as in method 500. The part of the transmission pattern, which is placed to the end of each frame, is selected here from the beginning of the  
20 transmission pattern.

- In step 601 the transmission pattern is defined. In step 602 the length of the frame and the length of the transmission pattern are determined. In the method, the index  $j$  is used to denote the items of the transmission pattern, and in step 603 the active indexes for each antenna are determined from the transmission pattern. An active  
25 index refers here to those transmission pattern items during which a symbol  $S$  is transmitted using a certain antenna. Consider on example, where transmission pattern is a simple alternating pattern and two diversity antennas are used. If one symbol  $S$  is transmitted, for example, in the beginning of each time slot, then the transmission pattern items correspond to a time slot. The transmission pattern can be  
30 represented, for example, with two numbers 1 and 2. The odd values of  $j$  are active for one antenna and the even values of  $j$  for the other antenna. If in a certain time slot of a pattern no symbol  $S$  is transmitted, then the respective value of  $j$  is not active for any antenna. Similarly, if in a certain time slot of a pattern both antennas are transmitting a symbol  $S$ , then the respective value of  $j$  is active for both  
35 antennas.

Index  $j$  runs from 1 to the length of the transmission pattern. The length of the transmission pattern may be expressed, for example, in symbols or in time slots.

5 In step 604 the value of index  $j$  is initialized to one. In the same step 604 index  $i$ , which refers to time units of a frame, is also initialized to one. Index  $i$  has to refer to a same time unit as index  $j$ . If  $n > 1$  symbols  $S$  can be transmitted in each time slot, then the index  $i$  may run, for example, from 1 to  $n$  times the number of time slots in a frame. In this case, the length of the transmission pattern would also be expressed in  $n$ 'th parts of a time slot.

10 In step 605 it is checked, if the current value of  $j$  is active, i.e. if any of the diversity antennas is expected to transmit a symbol  $S$  in the current time unit. If  $j$  is active, then in step 606 the antenna(s) specified by the transmission pattern transmits the symbol  $S$ . After transmission, in step 607 it is checked, if the end of frame or end of pattern has been reached. If  $j$  is not active, then this checking is done directly after step 605. If either the end of frame or the end of the pattern has been reached, then  
15 the transmission pattern is started afresh by initializing  $j$  to 1 in step 609. If the current time unit is in the middle of the frame and the end of the pattern is not reached, then index  $j$  is pointed to the next item in the transmission pattern. This takes place in step 608, where  $j$  is increased by one.

20 After index  $j$  has been updated in either step 608 or 609, in step 610 it is checked, if the end of the frame has been reached, i.e. if index  $i$  has reached its maximum value. If the end of the frame has been reached, then in step 612 index  $i$  is initialized to one. If the current time slot is in the middle of the frame, then index  $i$  is pointed to the next time unit by increasing it by one in step 611. After the value of index  $i$  has been updated, it is checked in step 605 if the current item of the transmission  
25 pattern is active.

As an example, consider a simple pattern whose length is two time slots and, for example, a synchronization symbol is transmitted once in a time slot. Index  $j$  thus has values 1 and 2. Further, consider that the pattern is alternating. The values 1 and 2 of index  $j$  may thus directly indicate the diversity antenna using which the  
30 synchronization symbol is transmitted. Using the term active index, this can be expressed by saying that, for example, for the primary diversity antenna the index value 1 is active, and for the auxiliary diversity antenna, the index value 2 is active.

If the length of the frame is  $m$  time slots, and  $m$  is an odd number, then as long as  $i < m$ , steps 608 and 609 are carried out in an alternating manner and the

synchronization symbols are transmitted from the two diversity antennas in an alternating manner. The pairs  $(i, j)$  in the consecutive transmission steps 606 are (1, 1), (2, 2), (3, 1), (4, 2), ...  $(m-2, 1)$ ,  $(m-1, 2)$ .

When index  $i$  is increased to value  $m$  in step 611, the pair  $(i, j)$  has value  $(m, 1)$  next time in step 606. Thereafter the check in step 607 results the initialization of  $j$ , because  $i = m$  indicates the end of the frame. In the consecutive step 612 index  $i$  is initialized, and the next time the transmission step 606 is entered, the value of the pair  $(i, j)$  is (1, 1). The transmission pattern is thus started afresh, when a new frame is started.

If the transmission pattern is, for some reason, defined to be longer than the frame, steps 607 and 609 take care also in this case that the transmission pattern is started afresh when a frame starts. The end of the transmission pattern is not used.

Fig. 7 shows a network element and an arrangement which employ a method according to the invention when they control the transmit of a certain sequence of symbols. The arrangement 700 for controlling the transmission of synchronization symbols comprises a control block 701, which controls the actual transmission of symbols  $S$  according to a transmission pattern. It chooses the diversity antenna for each symbol  $S$ . The transmission pattern is generated in a generation block 705 and the sequence of symbols  $S$  may be generated in the symbol block 704, which is not part of the arrangement 700.

The arrangement 700 comprises also an indication block 702, which is responsible for indicating the antenna using which the first symbol  $S$  of the sequence is transmitted. It also comprises a starting block 703, which, for example, detects the beginning of a frame, and starts the generation of the transmission pattern again from the beginning. The arrangement 700 may use any transmission method according to the invention. The block 701-705 may be implemented using, for example, microcontrollers and suitable program code.

The control arrangement can be implemented in the same network element which is responsible for transmitting the sequence of symbols. Fig. 7 shows a network element 710 which in addition to the arrangement 700 comprises two antennas 721 and 722. The arrangement controls the transmission of the symbols  $S$ , and the actual transmission is done using the antennas. The network element 710 presented in Fig. 7 may be, for example, a base station of the WCDMA system.



It is also possible to control the transmission of a certain sequence of symbols in another network element than in the one that transmits the symbols. The arrangement 700 can be a part of, for example, the Radio Network Controller (RNC) of the WCDMA system.

- 5 While this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various other embodiments of the invention will be apparent to persons skilled in the art upon reference to this description. It is therefore contemplated that the appended claims will cover any such modifications of the embodiments as fall within the true scope and spirit of the invention.

10 The WCDMA system has been presented as an example of a cellular network where a method according to the invention can be applied. It does not restrict the use of a method according to the invention to WCDMA networks.

- 15 Frames and time slots have been used here as examples of the hierarchical structures using which information is transmitted over a radiolink. The names of these structures may vary from system to system and a method according to the invention can be applied in any system where information is transmitted over radiolink in hierarchical structures.

- 20 The method according to the invention can be used to transmit any sequence of symbols. The invention does not restrict the type or values of the symbols that are transmitted using a method according to the invention. The sequence may contain, for example, only symbols of one value, as the synchronization symbols in WCDMA system. The sequence may also be, for example, a periodic sequence, where certain symbols are repeated. The length of the period does not have to be  
25 any multiple of the pattern length, nor the pattern length need to be any multiple of the sequence period.

# Claims

1. A method (300, 400, 500) for transmitting a certain sequence of symbols, where
  - a frame is constructed of a certain number of consecutive symbols,
- 5
  - the symbols belonging to the sequence are transmitted (404, 502, 606) using at least two antennas and
  - the transmission of the sequence of symbols is characterized (401, 601) with a certain transmission pattern, **characterized** in that
  - the transmission of the sequence of symbols is started (402) from a predefined
- 10 antenna and
  - when a partial transmission pattern is used in the end of a frame, the transmission pattern is started (403, 405) from the beginning in the beginning of a next frame.
2. A method (500, 600) according to claim 1, where
  - the length of the transmission pattern is shorter than the length of a frame, and
- 15
  - the length of the frame is not a multiple of the length of the transmission pattern, **characterized** in that during each frame
  - the transmission pattern is repeated (502) until the length of the rest of the frame, which length is the length of the transmission pattern multiplied by the number of the repetition times within the frame subtracted from the length of the frame, is less
- 20 than the length of the transmission pattern and
  - thereafter only a certain part, whose length is the length of the rest of the frame, of the transmission pattern is used (503).
3. A method according to claim 2, **characterized** in that the part of the transmission pattern is selected (609) from the beginning of the transmission pattern.
- 25 4. A method according to claim 2, **characterized** in that the length of the transmission pattern is an even number and the length of the frame is an odd number.
5. A method according to claim 4, where the sequence of symbols is transmitted using a first antenna and a second antenna, **characterized** in that the transmission pattern is an alternating pattern and the length of the transmission pattern is two.
- 30 6. A method according to claim 1, where each frame consists of a certain number of consecutive time slots and each time slot consists of a certain number of consecutive symbols, **characterized** in that one symbol belonging to the sequence of symbols is transmitted in each time slot.

7. A method according to claim 1, where each frame consists of a certain number of consecutive time slots and each time slot consists of a certain number of consecutive symbols, **characterized** in that at least one symbol belonging to the sequence of symbols is transmitted in each time slot.
- 5 8. A method according to claim 1, where each frame consists of a certain number of consecutive time slots and each time slot consists of a certain number of consecutive symbols, **characterized** in that at least in one of the time slots at least one symbol belonging to the sequence of symbols is transmitted.
9. A method according to claim 1, **characterized** in that the length of the transmission pattern is larger than the length of the frame.
- 10 10. A method according to claim 1, **characterized** in that the transmission of the sequence of symbols is started from the primary antenna that transmits the common pilot signal.
11. A method according to claim 1, **characterized** in that the sequence of symbols is transmitted in downlink direction in a cellular network.
- 15 12. An arrangement (700), which comprises control means (701) for controlling the transmission of a sequence of symbols according to a certain transmission pattern and using at least two antennas, **characterized** in that it further comprises  
- indication means (702) for indicating the antenna from which to transmit the first  
20 symbol belonging to the sequence and  
- starting means (703) for starting the transmission pattern from the beginning in the beginning of a next frame, when a partial transmission pattern is used in the end of a frame.
13. A network element (710), which comprises control means (701) for controlling  
25 the transmission of a sequence of symbols according to a certain transmission pattern and using at least two antennas, **characterized** in that it further comprises  
- indication means (702) for indicating the antenna from which to transmit the first  
symbol belonging to the sequence and  
- starting means (703) for starting the transmission pattern from the beginning in the  
30 beginning of a next frame, when a partial transmission pattern is used in the end of a frame.
14. A network element according to claim 13, **characterized** in that it is a radio network controller of a spread spectrum system.



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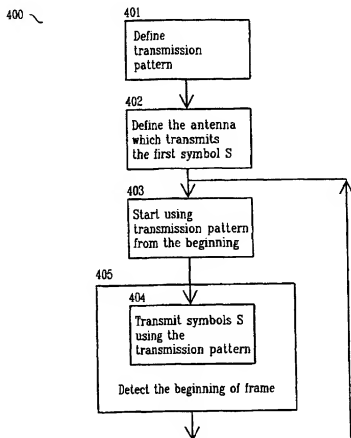
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(54) Title: METHOD FOR TRANSMITTING A SEQUENCE OF SYMBOLS



(57) Abstract: The invention relates to a method (300, 400, 500) for transmitting a certain sequence of symbols, where a frame is constructed of a certain number of consecutive symbols, the symbols belonging to the sequence are transmitted (404, 502, 606) using at least two antennas and the transmission of the sequence of symbols is characterized (401, 601) with a certain transmission pattern. The method according to the invention is characterized in that the transmission of the sequence of symbols is started (402) from a predefined antenna and the transmission pattern is started (403, 405) from the beginning in the beginning of each frame. The invention also relates to an arrangement (700) and to a network element (710) for controlling the transmission of a sequence of symbols.

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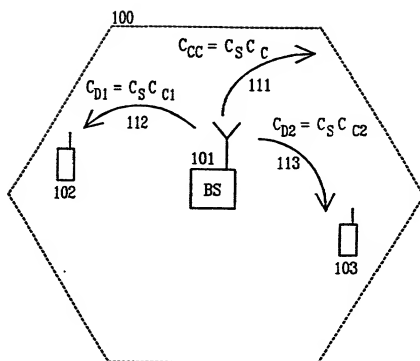


FIG. 1 PRIOR ART

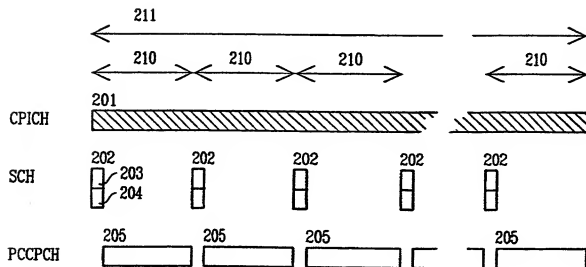


FIG. 2 PRIOR ART

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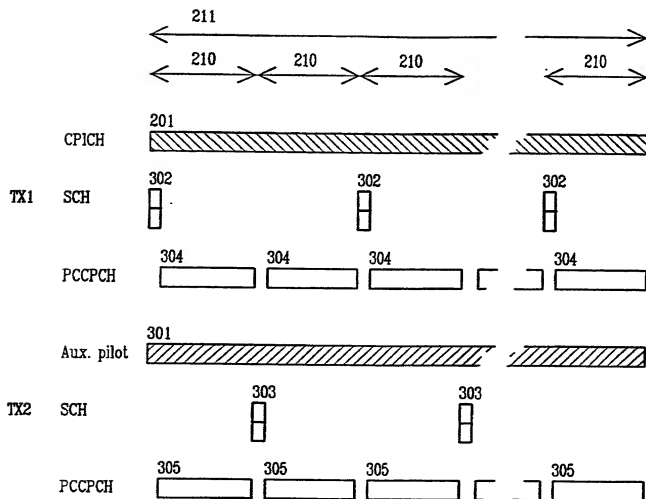


FIG. 3 PRIOR ART

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400 ~

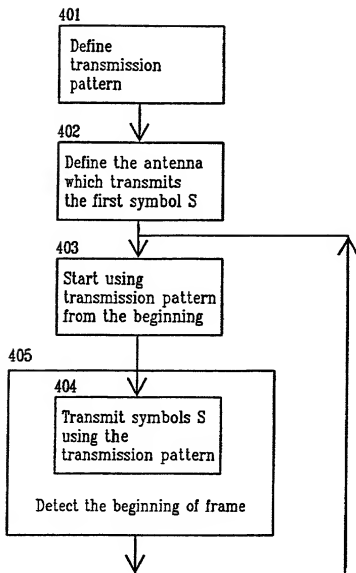


FIG. 4



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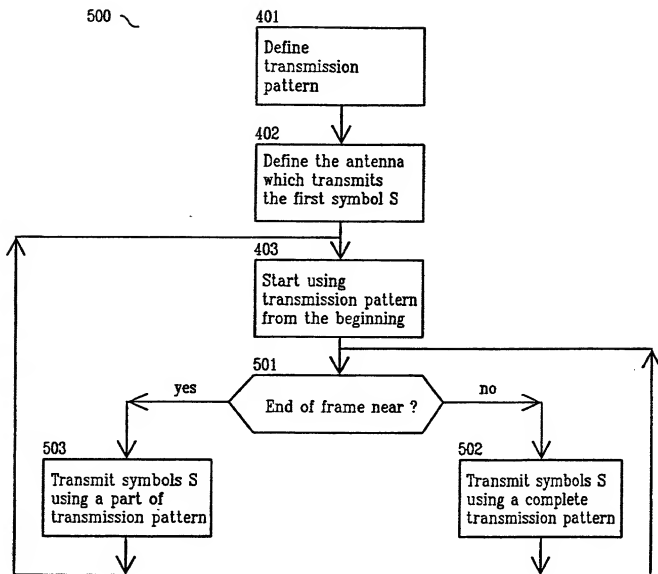


FIG. 5

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600 ~

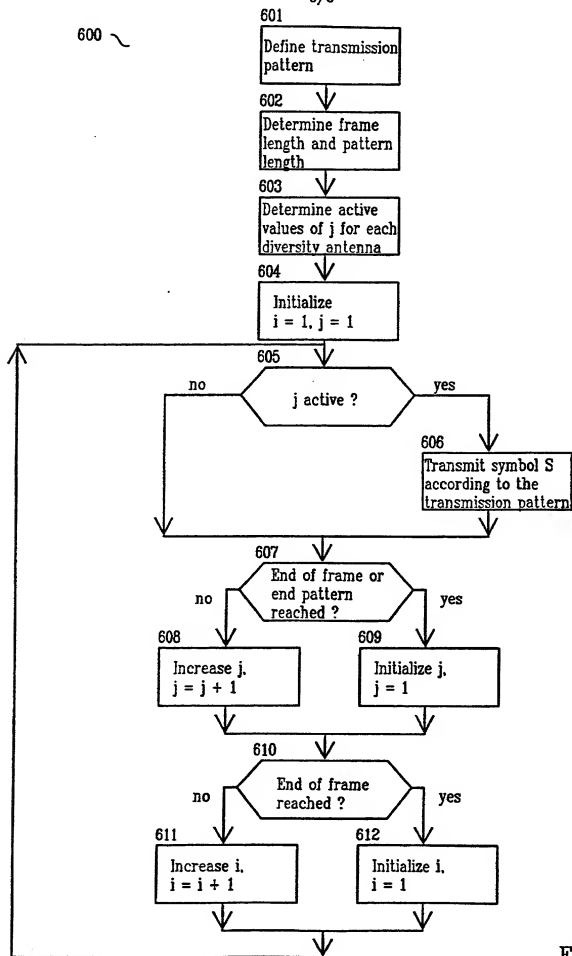


FIG. 6

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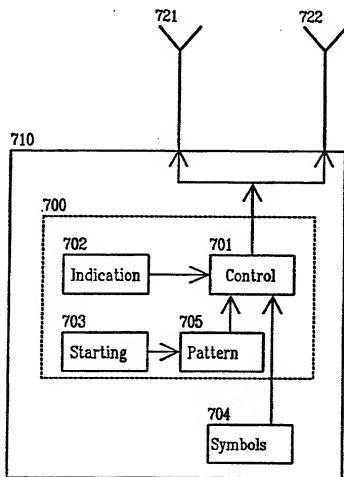


FIG. 7

BP 103113  
NC 24835

Docket No.: 297-010742-US (PAR)

**DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION****English Language Declaration**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: **METHOD FOR TRANSMITTING A SEQUENCE OF SYMBOLS**

the specification of which

(check one)

- ☐ is attached hereto.
- ☒ was filed on 6 July 2000 as PCT International Application Number PCT/FI00/00620 and was amended on (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International Application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

**Prior Foreign Application(s)**

(Number)	(Country)	(Day/Month/Year Filed)	Priority Not Claimed
991589	Finland	9 July 1999	<input type="checkbox"/>
PCT/FI00/00620	PCT	6 July 2000	<input type="checkbox"/>
			<input type="checkbox"/>
			<input type="checkbox"/>

10030706 010702

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

I hereby claim the benefit under 35 U.S.C. Section 120 of any United States application(s), or Section 365(c) of any PCT International Application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International Application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C.F.R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)

(Filing Date)

(Status)  
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)  
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)  
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

All attorneys listed under Customer No.: 2512

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Customer No.: 2512

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11.12.2001

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Full name of fourth inventor:

Fourth inventor's signature:

DATE

Residence address:

Citizenship:

Post Office Address:

Full name of fifth inventor:

Fifth inventor's signature:

DATE

Residence address:

Citizenship:

Post Office Address:

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